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SCIENTIFIC BOOKS

Chemical Analyses of Igneous Rocks. Published from 1884 to 1913 inclusive. With a critical discussion of the character and use of analyses. By HENRY STEPHENS WASHINGTON. U. S. Geological Survey, Professional Paper 99, Washington, 1917.

The Quantitative Classification of igneous rocks is one of the many very important contributions which America has made to the science of geology. As is well known it is the product of the labors of four distinguished petrographers—Professor Iddings, Professor Pirsson, Dr. Whitman Cross and Dr. H. S. Washington—and is based on the chemical composition of rocks rather than on their mineralogical character which formed the basis for the various older classifications.

In the earlier years of geological science but little attention was paid to the chemical composition of rocks, except in a very general way. Later when the chemical analysis of rocks came to be more common, the analyses were carried out in a very careless way since the rocks were considered to be merely aggregations of certain minerals the relative proportions of which might vary more or less, and, consequently, the chemical composition

of the whole would be represented with sufficient accuracy even although an error of a per cent. or two in any one or other of the chemical constituents might be made. Now, however, the study of these igneous rocks is regarded as a study of silicate solutions and their equilibria and the subject has thus become a special branch of physical chemistry. Such being the case the accurate chemical analysis of igneous rocks is recognized to be of the greatest importance, and the correct understanding of the composition of these rocks is now seen to have a very far-reaching and important bearing on some of the most fundamental problems of the science.

As the importance of the chemical composition of rocks became increasingly recognized, attempts were made to collect and correlate all published analyses. The most notable of these was that of Justus Roth whose "Tabellen" of rock analyses were published by intervals between 1869 and 1884, and the more recent collection of A. Osann.

The present work by Dr. Henry S. Washington of the Carnegie Institution, Washington, goes far beyond these. Every serial whether published by a Survey, Society, or other organization, which might conceivably contain petrographic material, has been examined volume by volume, the examination embracing publications from the year 1883 to 1915. As all the analyses of importance published before 1883 had already been collected by Roth and are embraced in the present list—and as Dr. Washington has spared neither time nor effort to include in his paper all analytical material which is worthy of consideration—the present collection of analyses may be said to be complete, perfect and final. To use a colloquial expression the volume under review is "the limit."

The total number of analyses tabulated by Dr. Washington amounts to no less than 8,602, and it is significant of the increased interest taken in rock analysis in recent years to note that in the thirteen years from 1901 to 1913 inclusive, nearly twice as many analyses were published as during the sixteen preceding years between 1884 and 1900. This accounts

for the great increase in size of the present volume as compared with that of Professional Paper 99 which appeared from the pen of Dr. Washington in 1903, and which contained the analyses published up to that date.

Not only has the number of analyses published in recent years increased but the quality of the analyses has improved greatly—this may be seen if the more recent analyses are critically examined by the standards set forth by Dr. Washington, and it is especially noticeable that the quality of the analyses published in the United States, Great Britain, Canada, Australia and France, is now excellent, while the German analyses show a dead level of mediocrity.

This improvement is to be attributed in no small measure to the influence of Dr. Washington himself, since in his papers he has continually pointed out and insisted upon the necessity for greater care and thoroughness in rock analysis. In Dr. Washington's book on *Mineral Analysis*, improved methods especially adapted to the analysis of rocks have been described and explained. It may be mentioned in this connection that within the last few months his remarkable skill as an analyst of this class of materials, has been put to very practical account in connection with the striking investigations which have been carried to such a brilliant conclusion by the staff of the Geophysical Laboratory at Washington, in the manufacture of optical glasses required for the use of the United States Army and Navy. All of these glasses before the war were imported, for the most part from Germany, but now as a result of these researches they can be, and are being, made in sufficient quantity for the requirements of the service, under the direction of these gentlemen, in certain factories in the United States, a new industry having thus been established in this country.

The analyses assembled in this great collection are arranged in their proper order, according to the position of their "norms" in the Quantitative Classification. In each case not only is the analysis itself reproduced, but the "norm" is also given (the "norms" of the whole 8,602 rocks having been re-calculated

and verified by Dr. Washington), as well as the locality, analyst, literature reference, and the name by which the rock is described by the author.

The analyses are arranged in four parts. Part I. embraces the "Superior Analyses of Fresh Rocks" and makes up the greater part of the volume. This is followed by Part II., which includes the "Superior Analyses which are Incomplete through the Non-determination of Some One or More Constituents." Part III. sets forth the "Superior Analyses of Weathered or Altered Rocks and Tuffs," while in Part IV. are gathered "Inferior Analyses" embracing those which are poor or bad.

The only errors to which attention is called are on p. 720, where in the Jacupirangite of Brazil the silica content should be given as 38.38 per cent. instead of 58.38 per cent. and on p. 1197, line 2, left column, where the caption British Guiana is omitted.

An excellent description of the Quantitative Classification itself, a tabular presentation of the divisions of names of the Quantitative Classification, the method of the calculation of the norm, together with tables of the molecular numbers and of the percentages of the norm molecules, are presented in five short appendices. It would subserve a very useful purpose if these appendices were reprinted separately, since they could be used much more readily in the form of a pamphlet of 30 pages than as part of the present massive tome embracing 1,200 pages. The reviewer hopes that the authorities of the United States Geological Survey will view favorably the suggestion that these appendices be issued as a separate paper.

Geologists will look forward to the discussion of "The Distribution of Magmas" and "The Average Rock" which are to be made the subjects of separate papers by the author, to appear later.

The excellent indexing of the volume and the high character of the press work are worthy of especial mention.

It is a volume which must find a place on the shelves of every petrographical laboratory in the world.

A lighter touch is given to this somewhat weighty subject—a connecting link with more transcendent things—by the text which appears in the upper corner of the page of preface. This is taken from Deuteronomy XXXII. 31, and reads as follows:—

For their rock is not as our rock, even our enemies themselves being the judges.

Certainly if the opponents of the Quantitative Classification have visited upon them the fate set forth as awaiting their representatives in the context of this passage from the Song of Moses, the Quantitative Classification of igneous rocks will be firmly established for all generations.

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A REVIEW OF SOME PAPERS ON FOSSIL MAN AT VERO, FLORIDA

IN the number of the *American Anthropologist* for the first quarter of 1918 the writer is publishing a paper which deals with the discovery of Pleistocene man in North America. In that paper notice is taken of the literature which had appeared up to the time of writing it on the finding of human remains at Vero, Florida. Since then other articles on the subject have appeared, and I feel constrained to review briefly some of them. One of these papers is the official account of Dr. Hrdlička.¹ The gist of this account is found in these words:

The only satisfactory explanation of the conditions can be found in the assumption that the remains are those of intentional burials.

Naturally, this means satisfactory to the writer of the report; for six other men have furnished explanations on the same subject, each apparently satisfactory to its author, and all differing much from that of Dr. Hrdlička. At least three of those six men are experts in the solution of geological problems, but not one of the six sustains Dr. Hrdlička in his theory of intentional burial. Meanwhile he hardly attempts to remove the difficulties which beset his assumption. His method may be defined as the easy one of solution by fiat.

¹ Rep. Sec. Smithson. Inst. for 1917, p. 10.

Three papers on the same subject appear in the *Journal of Geology* for October–November, 1917. They are the outcome of a week's collaboration and consultation at Vero on the part of Drs. E. H. Sellards, R. T. Chamberlin, and E. W. Berry. No comment is here made on Sellards's paper; for, so far as Sellards has expressed himself, the present writer is in accord with his views.

Dr. Berry's paper deals especially with the fossil plants found in the muck bed; but he discusses other important matters. He concludes that the muck deposit and, of course, the stratum of sand beneath it, belong undoubtedly to the Pleistocene; that the human remains were not buried intentionally; and that man lived there contemporaneously with the extinct vertebrates. He generously excuses Dr. Chamberlin's theory of the in-wash of the fossil bones and Dr. Hrdlička's theory of intentional burial on the ground that the age of the extinct vertebrate fauna had been overestimated. It is to be regretted if these experienced men were constrained to resort to desperate measures in order to save their anthropological theory.

It seems to the writer that Berry assumes to be true too many debatable matters. He says that the shell marl which underlies the other beds at Vero is late Pleistocene in age; and he bases this statement on the asserted fact that its species all now exist in near-by waters. Mansfield's list of mollusks² does not exactly support this statement. There are more than a dozen species about which there is doubt of one kind or another. Furthermore, if the molluscan fauna were not essentially that of Recent seas the beds would have to be assigned to the Tertiary.

Again, Berry takes it for granted that the lowest and youngest terrace, the Pensacola, is of late Pleistocene age; but this view lacks confirmation. This terrace is supposed to continue northward into the Talbot of Maryland and thence into the Cape May of New Jersey. The present writer is not inclined to question the conclusion of Salisbury and Knapp that the Cape May was coincident with the Wis-

² Ninth Ann. Rep. Fla. Geol. Surv., p. 78.